TERMINAL NORMAL SHOCK BLEED SYSTEM

By

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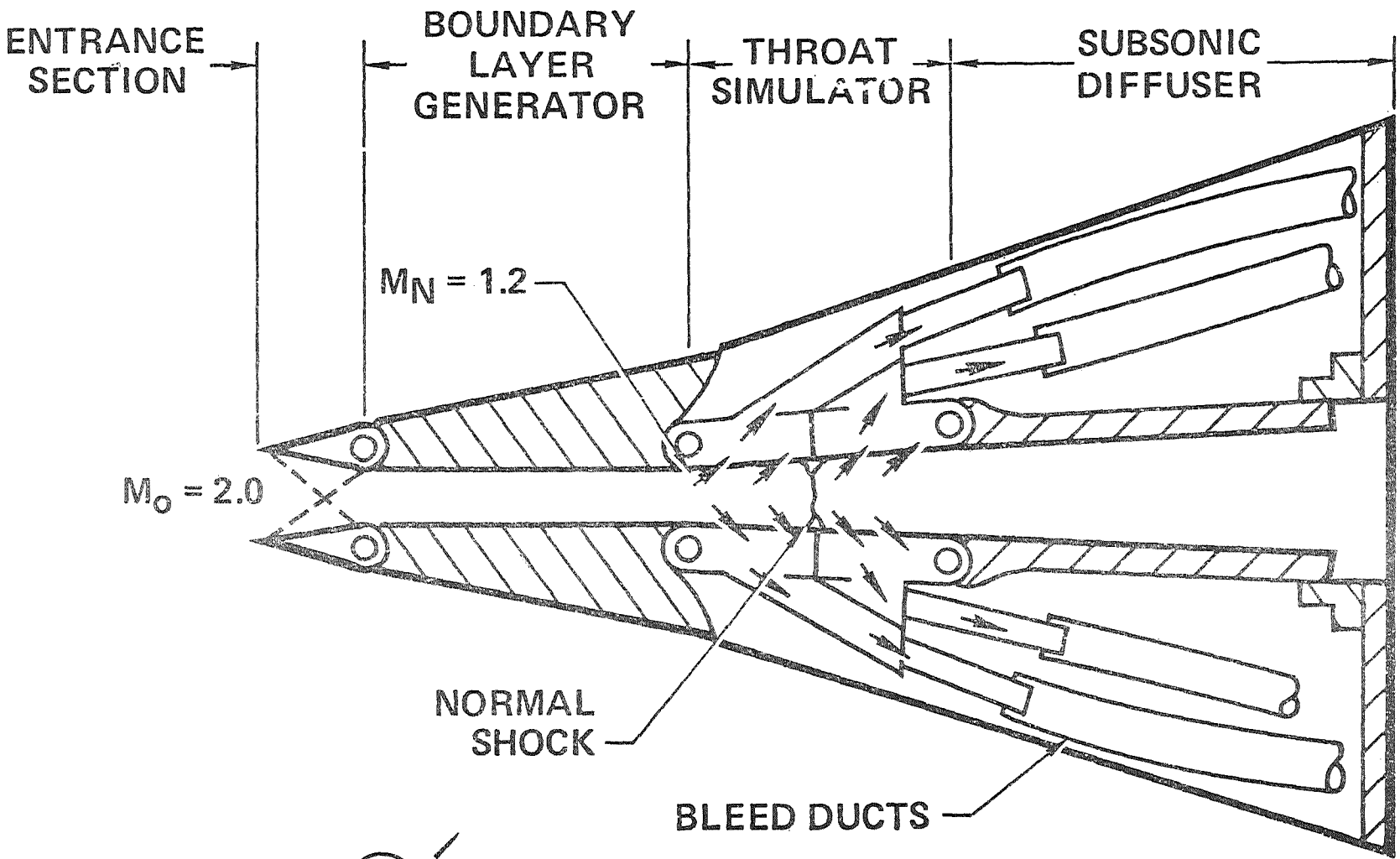
ABSTRACT

The results of an experimental program investigating the design of mixed compression inlet throat contours and bleed configurations are presented and discussed. Test variables include approach Mach number, wall divergence angle, porosity and bleed hole diameter. Test measurements include total pressure recovery, bleed flow and static pressure profiles.

High Speed Inlet Investigation - Under contract to the Air Force Flight Dynamics Laboratory, a program is being conducted to define the critical technology areas and develop preliminary design criteria for inlets operating in the Mach 3 to 6 flight regime. The program approach is discussed and the model concept is described in detail.

NORMAL SHOCK/BOUNDARY LAYER INTERACTION



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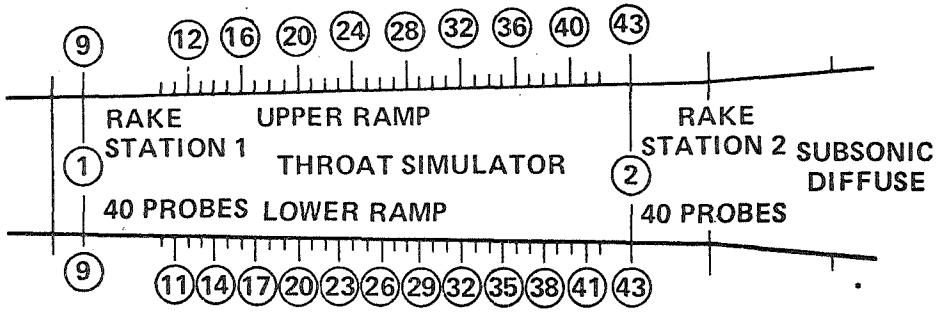
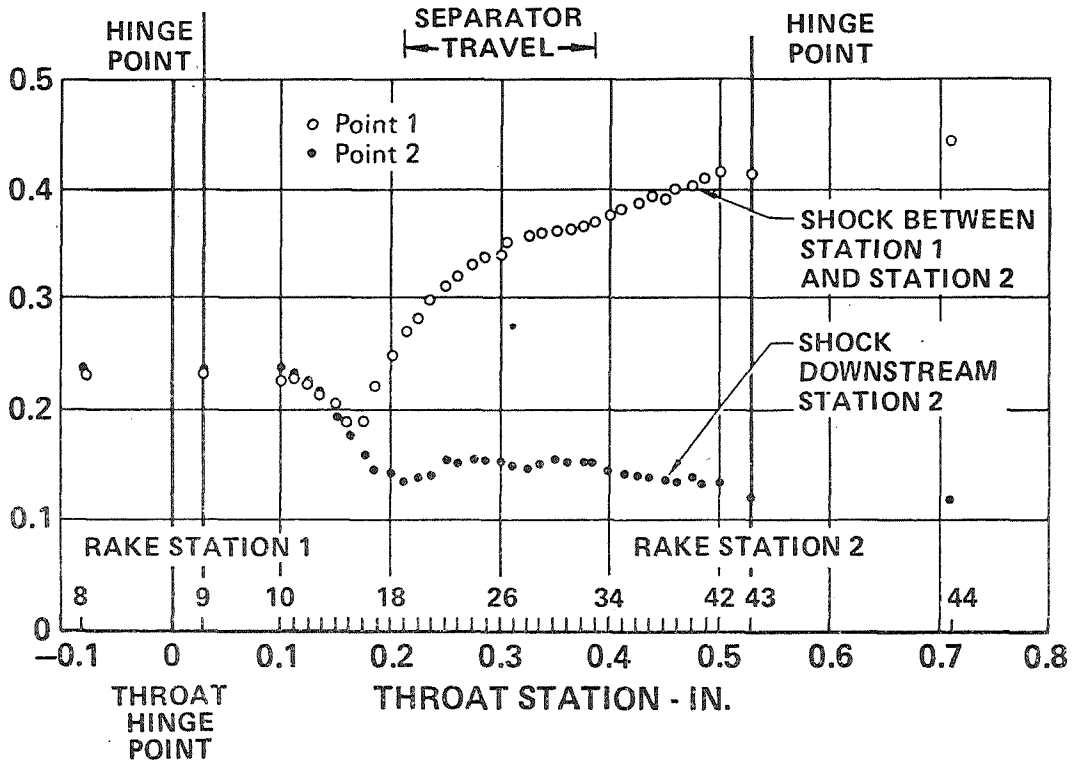
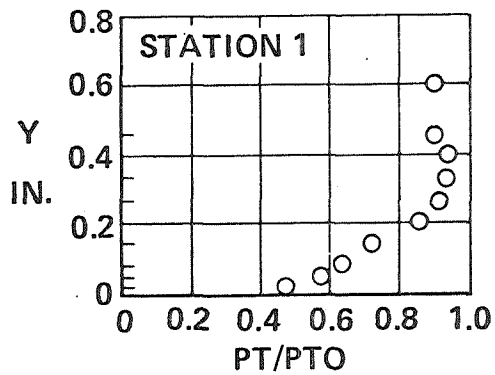
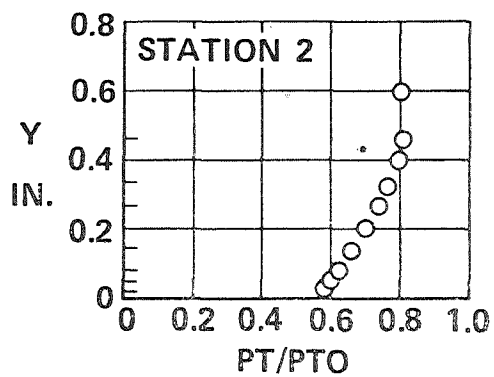
TYPICAL DATA FROM TEST









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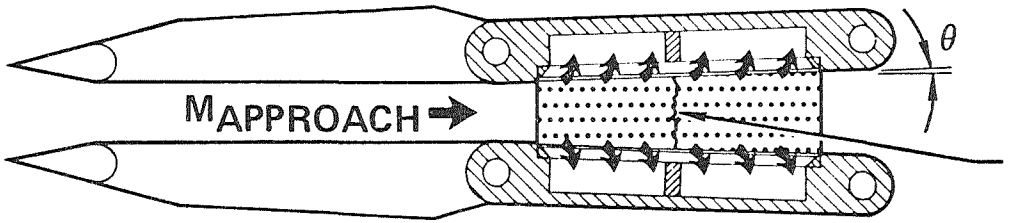
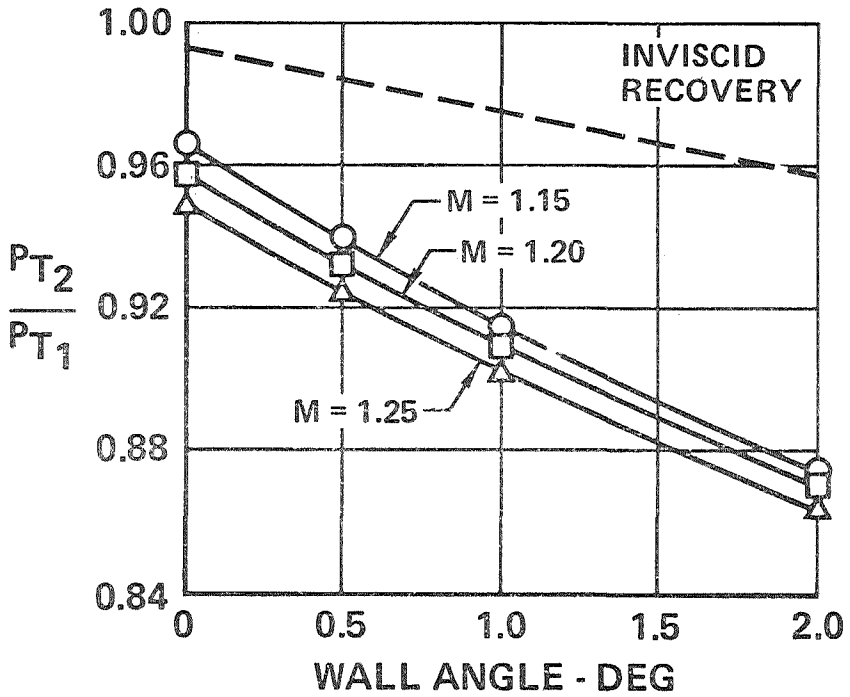
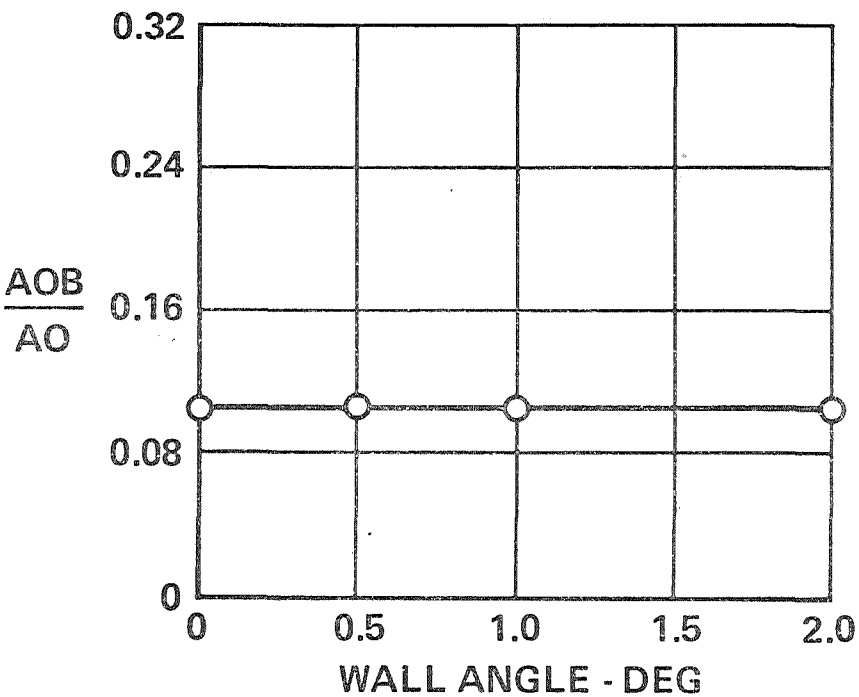
EFFECT OF APPROACH MACH NUMBER AND DIVERGENCE

3% POROSITY 0.031 DIA HOLES ALL HOLES OPEN







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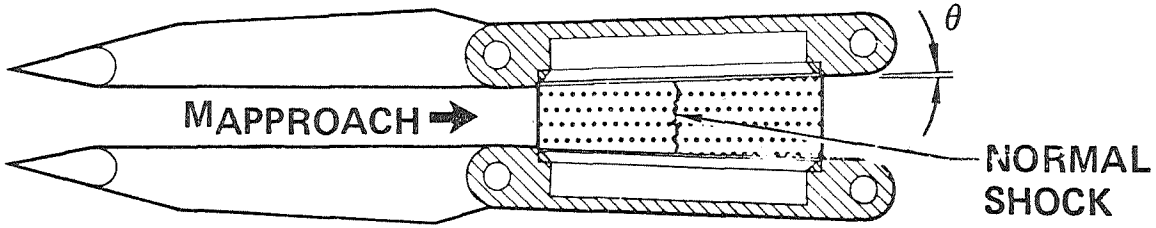
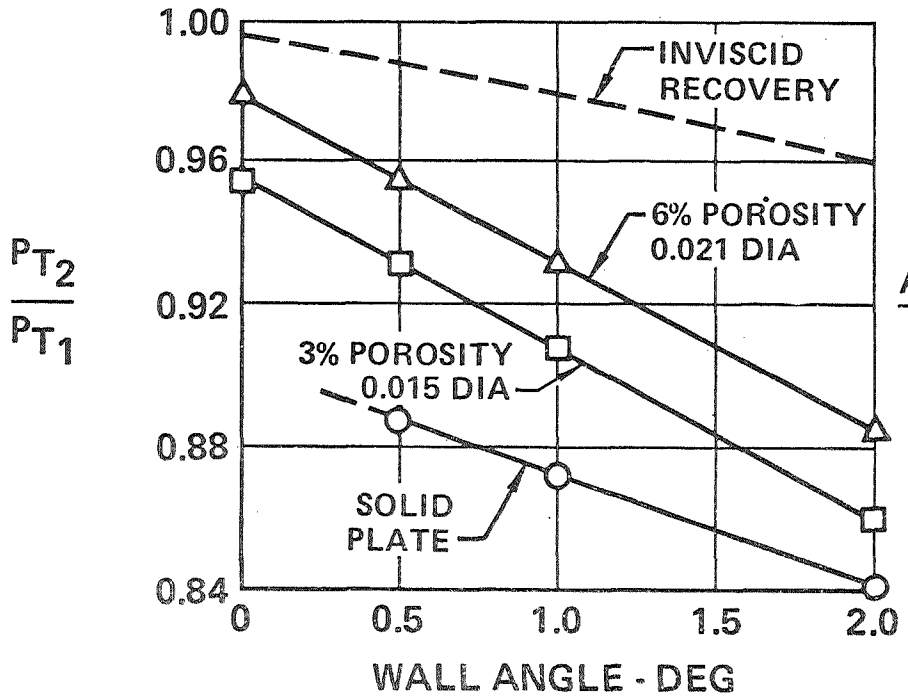
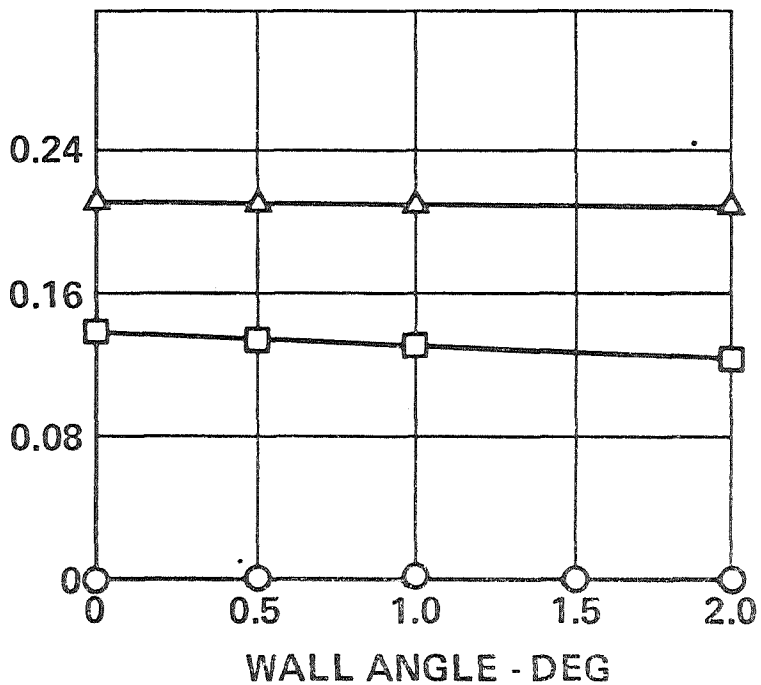
EFFECT OF BLEED POROSITY

APPROACH MACH NUMBER 1.20







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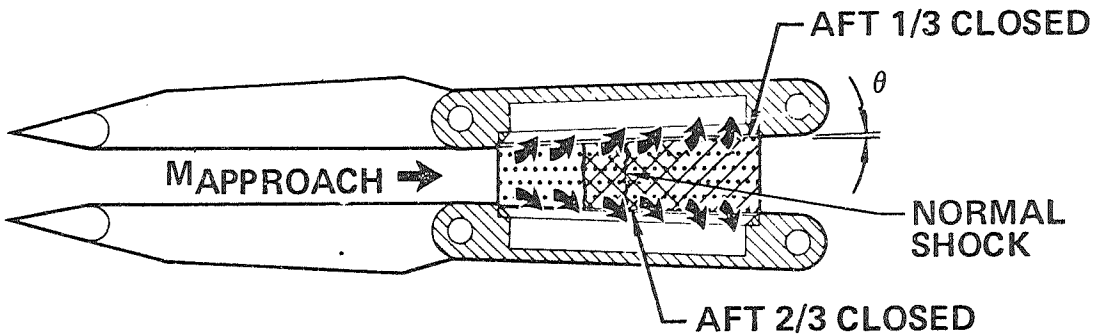
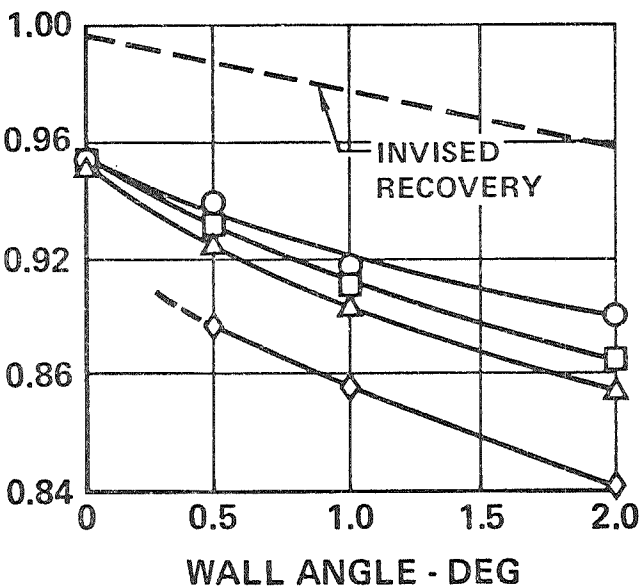
EFFECT OF BLEED AREA

3% POROSITY 0.31 DIA HOLES APPROACH MACH NUMBER 1.20

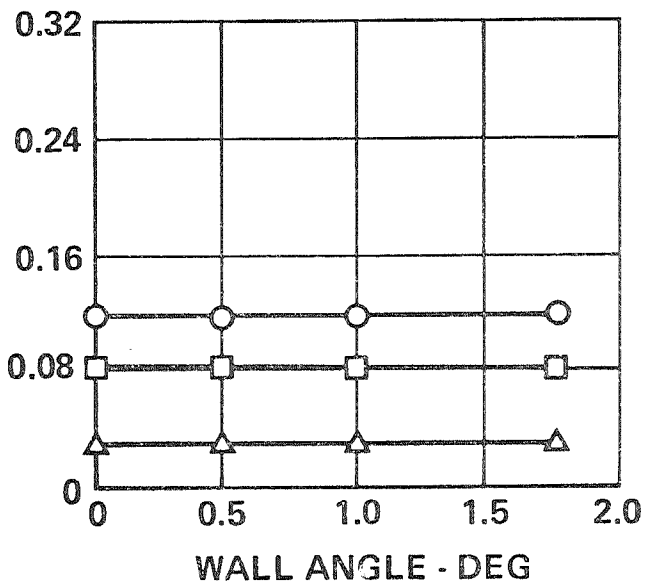


○ All Holes Open
□ Aft 1/3 Closed
△ Aft 2/3 Closed
◇ Solid Plate



$\frac{P_{T_2}}{P_{T_1}}$

$\frac{AOB}{AO}$



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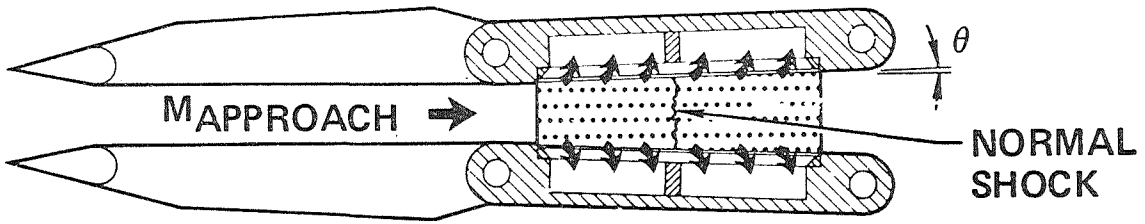
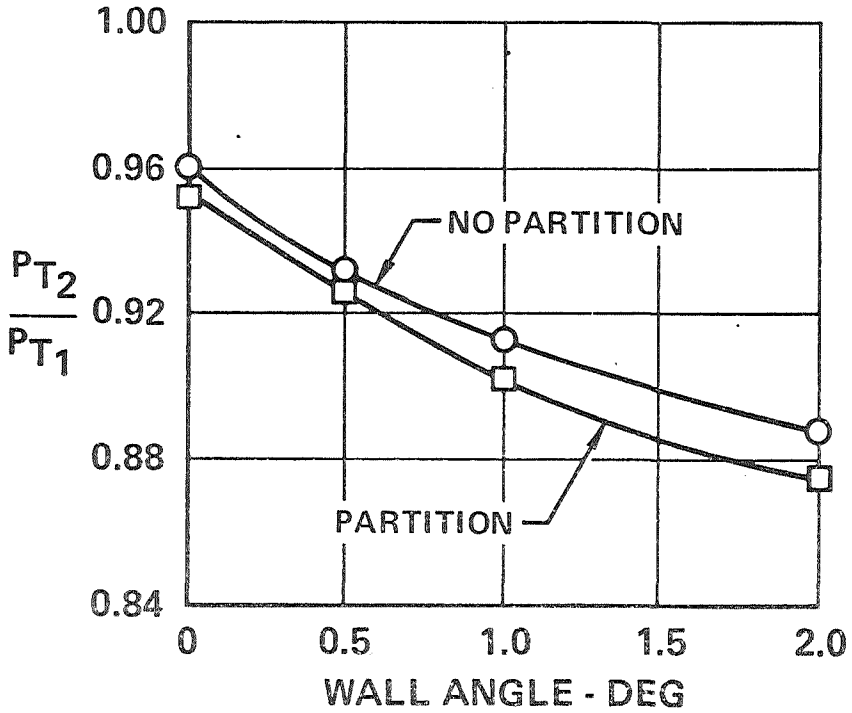
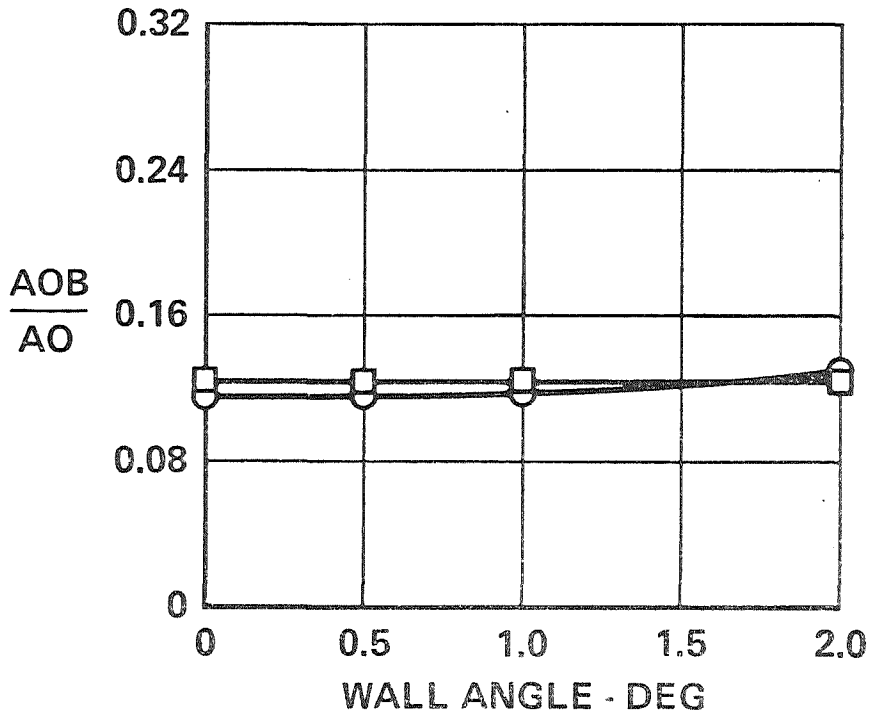
EFFECT OF THE BLEED SEPARATOR

3% POROSITY 0.060 DIA HOLES APPROACH MACH NUMBER 1.20







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PRELIMINARY DESIGN GUIDELINES

- A CONSTANT AREA THROAT REGION (0^{o} WALL ANGLE) PROVIDES HIGHEST RECOVERY
- BLEED IN THE THROAT REGION IS REQUIRED TO:
  - OPERATE THE THROAT AT 0^{o} WALL ANGLE
  - ACHIEVE ACCEPTABLE LEVELS OF RECOVERY THROUGH THE SHOCK
- BLEED SHOULD BE APPLIED UPSTREAM OF THE SHOCK LOCATION
- UNIFORM BLEED THROUGHOUT THE THROAT REGION PROVIDES AN INCREASE IN RECOVERY, BUT IS ACCOMPANIED BY A PENALIZING INCREASE IN BLEED

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ADDITIONAL SUGGESTED RESEARCH

- INVESTIGATE A WIDER RANGE OF APPROACH MACH NUMBERS (1.10-2.00)
- INVESTIGATE A THROAT ASPECT RATIO CORRESPONDING TO A HIGHER FREESTREAM MACH NUMBER
- INVESTIGATE THE EFFECT OF UNCHOKING THE BLEED HOLES
- CHECK FOR REQUIREMENT OF BLEED PLENUM PARTITION WHEN BLEED HOLES OPERATE UNCHOKED

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HIGH SPEED INLET INVESTIGATION
AFFDL CONTRACT F33615-75-C-3072

OBJECTIVE:

- DEFINE THE CRITICAL TECHNOLOGY AREAS AND DEVELOPE PRELIMINARY DESIGN CRITERIA FOR INLETS OPERATING IN THE MACH 3 TO 6 FLIGHT REGIME

APPROACH:

- REVIEW AVAILABLE MISSION STUDIES AND PERFORM NEW STUDIES IN ORDER TO DEFINE THE CRITICAL TECHNOLOGY AREAS
- CONDUCT EXPERIMENTAL PROGRAM TO INVESTIGATE SELECTED CRITICAL TECHNOLOGY AREAS
- DEVELOP DESIGN CRITERIA

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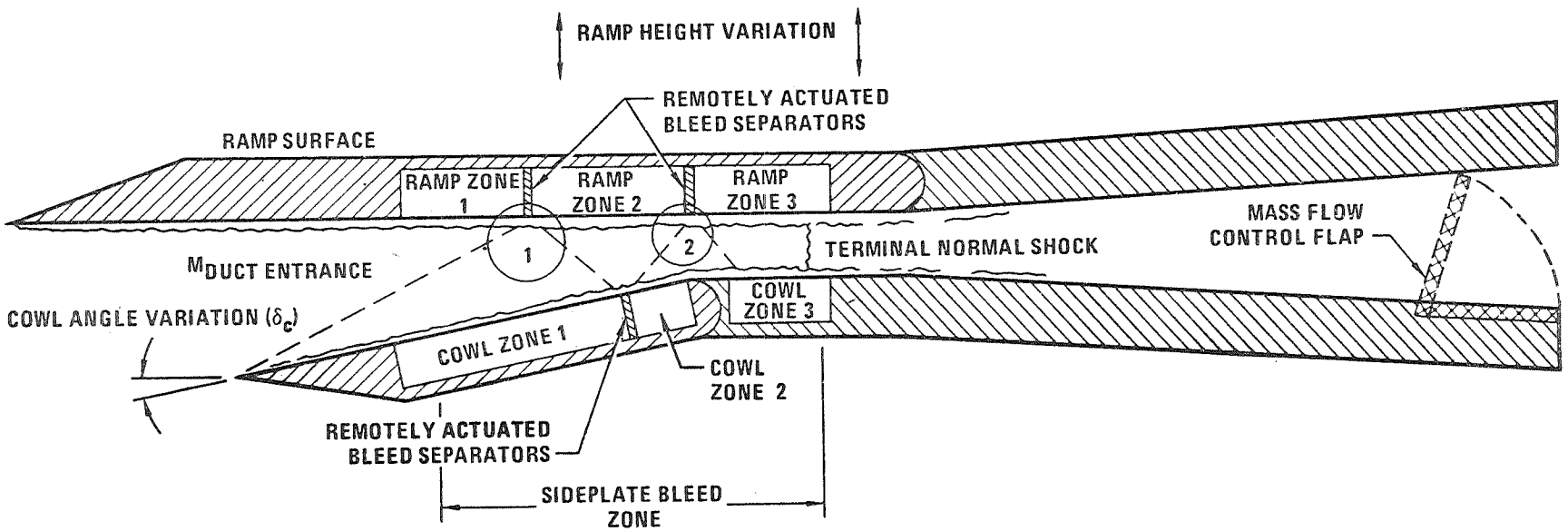
TEST APPARATUS CONCEPT



SELECTED TECHNOLOGY AREAS

- SUPERSONIC COMPRESSION RATE/BLEED RATE
- THROAT MACH NUMBER/BLEED RATE
- INLET ASPECT RATIO/BLEED RATE

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